theoretical overview is not a convincing exposition of the importance of research in this area. Perhaps the most important and interesting aspect of the body schema concept is that by which it is seen as the internalized organization of the mobile body which underlies the ability to coordinate movements in simple and complex skills. This aspect is barely hinted at in this volume.

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Plant Products

The Biochemistry of Alkaloids. TREVOR ROBINSON. Springer-Verlag, New York, 1968. x + 152 pp., illus. $9.75. Molecular Biology, Biochemistry, and Biophysics, vol. 3.

The presence of alkaloids in plants commands attention. Their startling effects on man and animals are something we have lived with throughout history, and at times must have turned history's course significantly. Yet within the plants which make them the alkaloids seem to produce no outstanding effects. We have had ample time to make their acquaintance, for it was at the beginning of the last century that alkaloids were isolated and shown to be the quintessences of such drugs as opium and cinchona. Since then the search for other alkaloids from plants has been prosecuted with great diligence and in recent years has been accompanied by an equally diligent and more sophisticated investigation of the chemical structure of alkaloids. But the question still remains whether these interesting dynamic substances have any particular role to play in the economy of the plant producing them. Robinson's book is concerned mainly with this question; as he points out, there are a number of other books which deal quite thoroughly with the occurrence, isolation, structure, and characteristics of alkaloids. This book deals mainly with how alkaloids are built up in the plant (biosynthesis) and whether they are utilized or degraded by further metabolic processes. Obviously this sort of information is necessary before the question of function in the plant can be settled. Biosynthesis is an aspect of the alkaloids that has been particularly studied during the last few decades, and the bulk of the book is devoted to this topic. In fact, apart from anything else, this book is an excellent, comprehensive yet compact discussion of this subject. It also includes as much biochemical information as is available. The general theories of alkaloid biosynthesis are discussed, and this discussion is followed by detailed consideration of alkaloids grouped according to their basic chemical structure (pyridines and pyrrolidines, tropanes, isoquinolines, morphinans, indoles, terpenoids, and so on). Two interesting chapters on the metabolism of alkaloids by bacteria and animals and on the biochemical pharmacology of alkaloids balance out the coverage.

The survey clearly shows that knowledge of biochemical aspects such as the enzymology of biosynthetic processes is still rudimentary; similarly, we are a long way from having a satisfactory explanation of function. The most obvious guess, that alkaloids impart survival value by protecting the plant from overgrazing by animals, meets with the answer that many alkaloid-containing plants are eaten by animals. In fact (p. 49), certain aphids are so anxious to get at the alkaloids of the broom plant that they will crowd round and suck the parts richest in alkaloids, and I myself have seen a flock of goats in the Sudan vigorously devouring the very poisonous leaves of *Datura metel* and *Argemone mexicana.*

More precise information, however, suggests possible roles in individual plants. For example, relationships have been found between certain alkaloids and pyridine nucleotides (p. 29) and between tomatine and growth hormones in the tomato plant (p. 5), and studies of the conversion of alkaloids such as nicotine (p. 34) and morphine (p. 69) to other compounds in the plants producing them suggest a metabolic role for these substances, as do the rapid changes in the alkaloidal patterns of *Catharanthus roseus* and *Conium maculatum* (p. 5).

In the light of the shift in emphasis in the study of secondary products in plants, I think this book is timely, and the incorporation of the all too scanty information on the biochemical aspects justifies its title.

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Biogenesis

Chemical Evolution. Molecular Evolution towards the Origin of Living Systems on the Earth and Elsewhere. MELVIN CALVIN. Oxford University Press, New York, 1969. x + 278 pp. + plates. Cloth, $9; paper, $4.50.

It is generally believed that life began on the earth sometime between 4.5 and 3.5 billion years ago. The first step in this process was the synthesis of simple organic compounds from the constituents of the reducing atmosphere. This was followed by the polymerization of these simple compounds, and finally by the organization of the polymers into a self-replicating structure. This sequence of events is sometimes called chemical evolution, although it is not evolution in the Darwinian sense, inasmuch as reproduction, mutation, and selection are not involved before the first living organism arises. There has been considerable experimental investigation in this area in the last 20 years, and the author of this book has made substantial contributions to the field. This book summarizes his view of the subject.

The first section of the book deals with the fossil record. There is a brief discussion of Post-Cambrian fossils and a detailed discussion of the Pre-Cambrian microfossils that have been found by Barghoorn and Schopf in cherts from the Bitter Springs, Gunflint, and the Fig Tree formations. An excellent addition to the book is five color plates showing samples of these Pre-Cambrian rocks; all these rocks would look about the same in black-and-white photographs. The next section, amounting to almost a third of the book, is an extended discussion of hydrocarbons and fatty acids found in present-day organisms and in rocks. Although this is an interesting subject, it does not tell us much about how life began. This section might well have been extended and made into a separate book.

The primitive reducing atmosphere and the sources of energy available for organic compound synthesis are taken up next, and the experiments synthesizing organic compounds under primitive earth conditions are then reviewed. From the standpoint of a worker in the field this section is too short, but for the average reader it is a good summary.

The story continues with the prob-